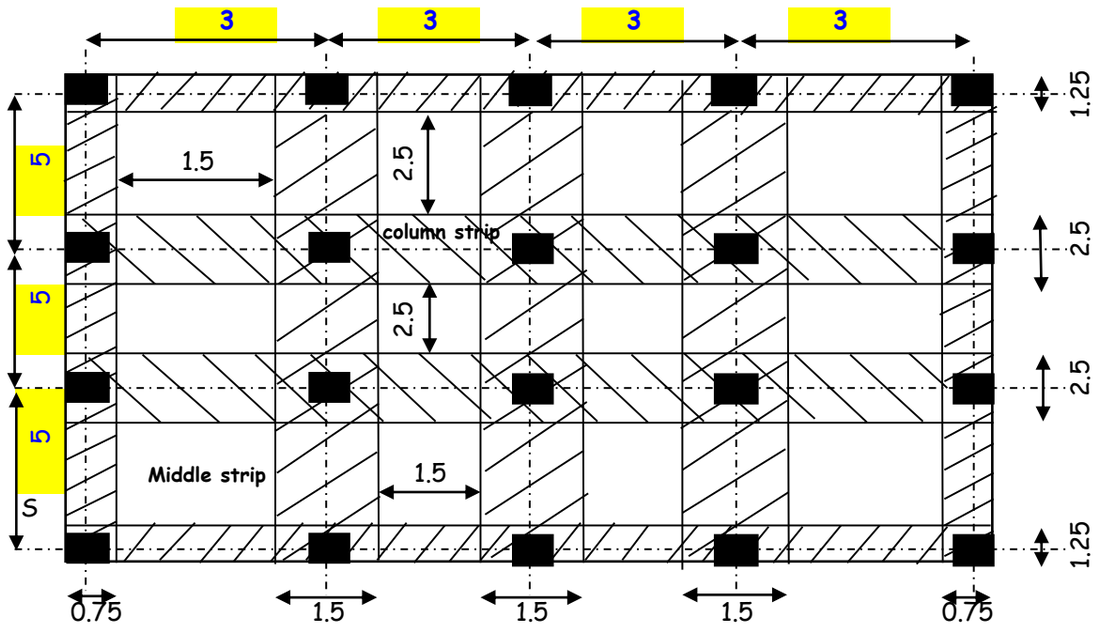
www.rcenggstudios.com	DESIGN OF FLAT SLAB	Date:	
		Rev:	



1. Characteritics compressive strength of concrete, fck	=	20	KN/m²
2. Yield strength of concrete, fy	=	415	KN/m²
3. Floor to Floor height fo column	=	4	m
4. Clear cover of slab	=	25	mm
5. Width of Edge beam	=	300	mm
6. Depth of Edge beam	=	450	mm
7. Diameter of bars	=	12	mm
8. Size of column(square/Rectangular)	=	230 x 450	mm

8 Depth of Slab

Basic L/d ratio for contineous slab	=	26	
Assume modification factor	=	1.5	1 To 1.5
Eff.depth required	=	Span/L/d ratio x M.F	
	=	5000/26x1.5	
	=	128.21	mm
Provide total depth	=	150	mm
Eff.depth provided	=	119	mm

9 Load calculations

Self wt. of slab	=	3.75	KN/m²
Floor finishes	=	2.5	KN/m²
Live Load	=	5	KN/m²
Total load, w	=	11.25	KN/m²
Ultimate design load, wu	=	17.775	KN/m²

10 Check for requirement of direct design method

a) No.of spans is more than 3

b) Long span/short, ratio = 0.6 < 2

c) Columns are not staggered

e) Successive span in each directions are equal

f) Design live load = 7.5 KN/m^2 < 3 x D.L = 16.875 KN/m^2

All the requirements are satisfied and, therefore, direct design method can be used

11 Drop

Minimum dimensions of drop in each direction

Length of drop along long span ≮ L1/3 = 1 m

Length of drop along long span ≮ L2/3 = 1.6667 m

Size of drop is conveniently selected such that it lies along the column strips.

Minimum width of column strip = 1.5 m

Provide drop size 1.5m x1.5m

Thickness of drop ≮ Thickness of slab/4 = 37.5 mm

Total thickness of drop, required = 187.5 mm

Total thickness of drop, provided = 600 mm

Eff. Thicness = 569 mm

12 Design moments in longitudinal direction

Mo = wu L_2 L_n^2/ 8

L_n = L1 - 0.89D

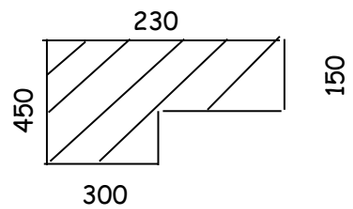
= 2795.3 mm > 1950 mm

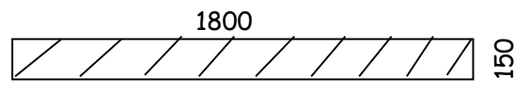
L_n = 2795.3 mm

Mo = 86.805 KN.m

13 Edge Beam

Beam must have a beam stiffness parameter $\alpha_c \geq 0.8$





C.g from top of L-beam, yt = 237.65 mm

C.g from bottom of L-beam, yb = 212.35 mm

Second moment of area of beam,I_b = 2.00E+09 mm4

For the edge beam along the long edge,

Second moment of area of slab,Is = 506250000 mm4

α_b = Ib/Is

= 3.96 > 0.8

O.K

For the edge beam along the short edge,

Second moment of area of slab,Is = 618750000 mm4

α_b = Ib/Is

		=	3.24 > 0.8
			O.K

14 Distribution of total design moments in longitutinal direction as panel moment

	Ratio, α_c	=	$\varepsilon k_c/ks$
Equalent side of column(if column has circular c/s)		=	230 mm
	εk_c	=	$2 \times (4EI_c/L_c)$
		=	466402 E N.mm
	k_s	=	$4EI_{s1}/L_{s1}$
		=	2E+06 E N.mm
	ac	=	0.2487
	factor, β	=	$1+1/\alpha_c$
		=	5.0201

A) Exterior Panel (Panel Moments)

Total Negative moment at exterior support	=	0.65 x Mo/β
	=	11.239 KN.m
Total Negative moment at Interior support	=	(0.75 -0.1/β)x Mo
	=	63.375 KN.m
Total Positive Moment at mid span	=	(0.63-0.28/β) x Mo
	=	49.846 KN.m

B) Interior Panel (Panel Moment)

Total Negative Moment	=	0.65 Mo
	=	56.423 KN.m
Total Positive moment	=	0.35 Mo
	=	30.382 KN.m

Distribution of Longitudinal Panel Moments into Strip Moments

(A) Exterior Panel (Strip moments)

a) Negative Panel moment

Negative moment at the exterior support in to be taken fully by colum strip, = 4.4958 KN.m

Negative panel moment at the interior support is distributed in the transverse direction

Negative moment in the column strip	=	19.012 KN.m
Negative moment in the middle strip	=	6.3375 KN.m

b) Total Positive Panel moment is dist. In trans. Dn

Positive moment in the column strip	=	11.963 KN.m
Positive moment in the middle strip	=	7.9753 KN.m

(B) Interior Panel moment (Strip moment)

a) Total -ve Panel moment

Negative moment in the column strip	=	16.927	KN.m
Negative moment in the middle strip	=	5.6423	KN.m

b) Total Positive Panel moment

Positive moment in the column strip	=	7.2916	KN.m
Positive moment in the middle strip	=	4.8611	KN.m

15 Design moments in longitudinal direction

Mo	=	wu L_2 L_n^c/ 8		
L_n	=	L1 - 0.89D		
	=	4795.3 mm	>	3250 mm
L_n	=	4795.3 mm		
Mo	=	153.28 KN.m		

16 Distribution of total design moments in longitutinal direction as panel moment

Ratio, α_c	=	$\varepsilon k_c/ks$
Equalent side of column(if column has circular c/s)	=	230 mm
εk_c	=	2 x ($4EI_c/L_c$)
	=	466402 E N.mm
k_s	=	$4EI_{s1}/L_{s1}$
	=	675000 E N.mm
ac	=	0.691
factor, β	=	$1+1/\alpha_c$
	=	2.4473

A) Exterior Panel (Panel Moments)

Total Negative moment at exterior support	=	0.65 x Mo/β
	=	40.711 KN.m
Total Negative moment at Interior support	=	(0.75 -0.1/β)x Mo
	=	108.69 KN.m
Total Positive Moment at mid span	=	(0.63-0.28/β) x Mo
	=	79.027 KN.m

B) Interior Panel (Panel Moment)

Total Negative Moment	=	0.65 Mo
	=	99.629 KN.m
Total Positive moment	=	0.35 Mo
	=	53.646 KN.m

Distribution of Longitudinal Panel Moments into Strip Moments

(A) Exterior Panel (Strip moments)

a) Negative Panel moment

Negative moment at the exterior support in to be taken fully by colum strip, = 27.14 KN.m

Negative panel moment at the interior support is distributed in the transverse direction

Negative moment in the column strip = 54.347 KN.m
Negative moment in the middle strip = 18.116 KN.m

b) Total Positive Panel moment is dist. In trans. Dn

Positive moment in the column strip = 31.611 KN.m
Positive moment in the middle strip = 21.074 KN.m

(B) Interior Panel moment (Strip moment)

a) Total -ve Panel moment

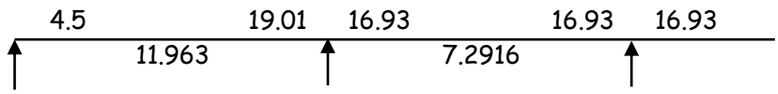
Negative moment in the column strip = 49.815 KN.m
Negative moment in the middle strip = 16.605 KN.m

b) Total Positive Panel moment

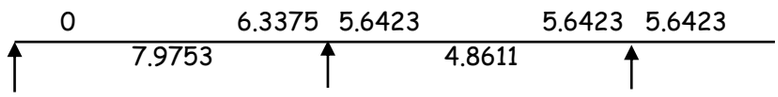
Positive moment in the column strip = 21.459 KN.m
Positive moment in the middle strip = 14.306 KN.m

17 Moment distribution

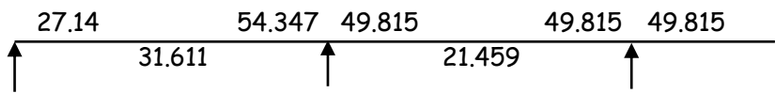
long direction (column strip)



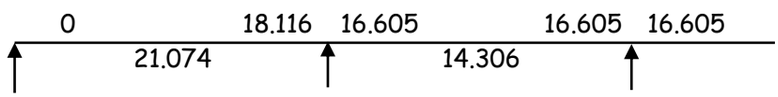
long direction (middle strip)



Short direction (column strip)



Short direction (middle strip)



18 Check for depth for flexure

Mu.lim = (0.36 x Fck x (xu.max/d) x (1- 0.42(xu.max/d)) x bd^2

xu.max/d = **0.48**

Mu.lim = 2.76 bd^2

d,reqd = $(Mu.lim/Qb)^{1/2}$

= $(19010000 / (2.76 \times 1000))^{1/2}$

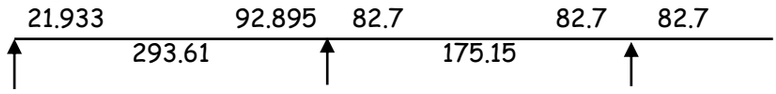
= **82.99** mm

82.99 < 119

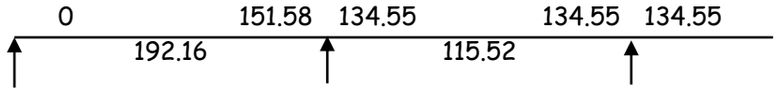
O.K

19 Reinforcement calculations

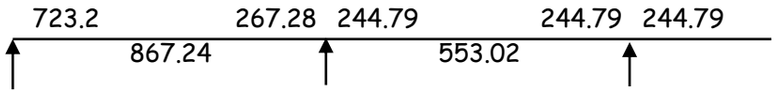
long direction (column strip)



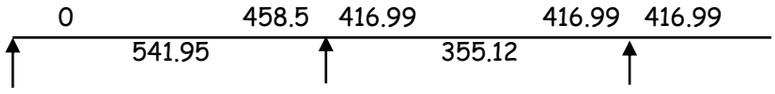
long direction (middle strip)



Short direction (column strip)

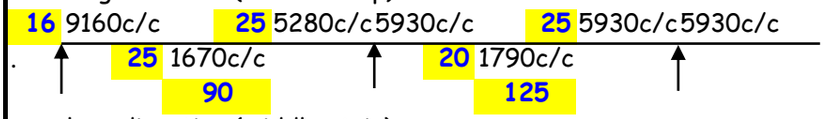


Short direction (middle strip)

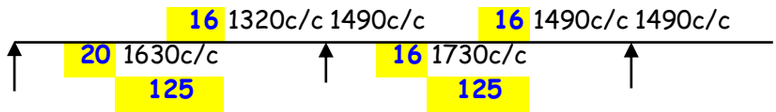


20 Bar dia/Spacing

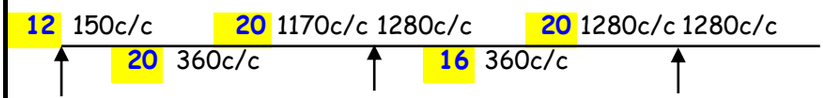
long direction (column strip)



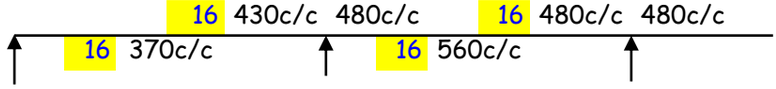
long direction (middle strip)



Short direction (column strip)



Short direction (middle strip)



21 Check for depth for deflection

lx/d, Actual	=	25.21
l/d, Max	=	B.V x M.F
pt,	=	100Ast/bd
	=	0.7342 mm2
fs	=	0.58x fyx(Ast required/Ast provided)
fs	=	238.91 N/mm^2
Modification Factor	=	1.1
l/d, Max	=	1.1 X 26
	=	28.6
		28.6>25.21
		O.K

22 Check for shear

a) Interior column

i) Around column

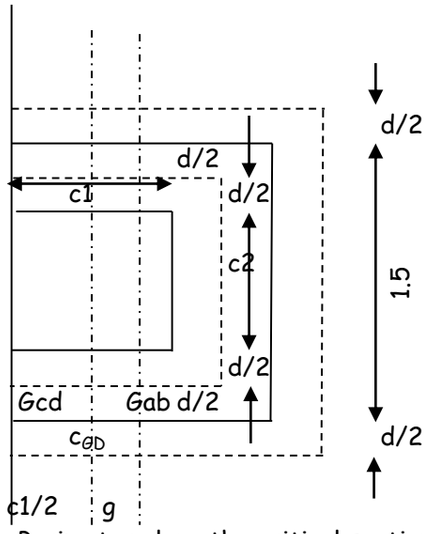
Weight of drop projection below slab	=	1.4063 KN/m2
Critical section length	=	386.5 mm
Critical section width	=	606.5 mm
Design shear at critical section	=	265.29 KN
Design shear stregth of concrete, ζ_{uc}	=	$0.25\ (fck)^{1/2}$
	=	1.118 mpa
Shear resistance of concrete	=	347.5 KN
	=	**Safe**

2) Around drop

Design shear at critical shear	=	220.03 KN
Shear reisistance of concrete	=	798.28 KN
	=	**Safe**

b) Exterior column

α_c	=	$1/1+2/3\ (a1/a2)^{1/2}$
a1	=	514.5 mm
a2	=	1019 mm
α_c	=	0.6786



Perimeter along the critical section	=	2a1+a2
	=	2048 mm
Design shear at critical section	=	132.79 KN

Area at critical section = 1E+06 mm2

G_{AB} = 129.25 mm

G_{CD} = 385.25 mm

g = 270.25 mm

Jc = $2da12/1^3 + 2a1d^3/12 + a2d \times G_{AB}2+2a1d(a1/2-G_{AB})^2$

= 4.799E+10 mm4

ζ_{max} = $Vu/Ac + (1-\alpha)(Mu-Vuxg)G_{AB}/ Jc$

= 0.1346 N/mm^2

ζuc = 1.118 mpa

= **Safe**